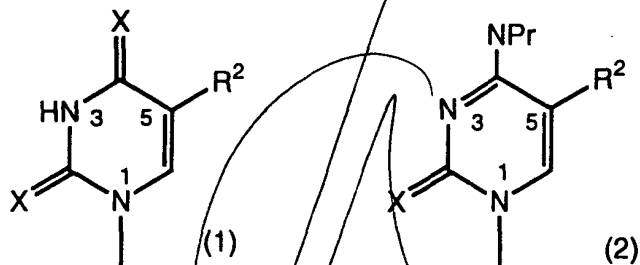


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CLAIMS

1. An oligomer comprising at least two nucleomonomers and pharmaceutically acceptable salts thereof wherein at least one of said nucleomonomers comprises a base of formula (1) or (2):



- wherein each X is independently O or S;
R² is a group comprising at least one pi bond connected to the carbon atom attached to the base; and
Pr is (H)₂ or a protecting group,
with the proviso that when at least one of said nucleomonomers of said oligomer comprises deoxyuridine 5-substituted by vinyl, 1-butenyl, 1-pentenyl, 1-hexenyl, 1-heptenyl, 1-octenyl, 1-propynyl, 1-butyryl, 1-hexynyl, 1-heptynyl, or 1-octynyl, then the remainder of the nucleomonomers comprising said oligomer are not solely comprised of phosphodiester linked 2'-deoxyadenosine, 2'-deoxyguanosine, 2'-deoxycytidine, thymidine or a combination thereof.

2. The oligomer of claim 1 wherein X is O.
3. The oligomer of claim 1 or 2 wherein R² is not phenyl.

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4. The oligomer of claim 1 or 2 wherein R² is cyano, C₂₋₁₂ 1-alkenyl or 1-alkynyl or is a C₂₋₁₂ heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in which one to three of the
5 ring atoms is N, S or O.

5. The oligomer of claim 4 wherein R² is C₂₋₈ 1-alkenyl or 1-alkynyl or is a C₂₋₈ heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in
10 which one ring atom is replaced by N and optionally in which a second ring atom is N, S or O.

6. The oligomer of claim 5 wherein R² is selected from the group consisting of phenylethynyl, 2-,
15 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and
20 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-, 4-, and 5-oxazolyl, 2- and 3-furanyl, 2- and 3-pyrrolyl, propenyl, vinyl and -C≡C-Z where Z is H, alkyl (C₁₋₁₀),
25 haloalkyl (C₁₋₁₀ with 1 to 6 halogen atoms) or heteroalkyl (C₁₋₁₀ with 1 to 3 heteroatoms).

7. The oligomer of claim 1 wherein R² is selected from the group consisting of 1-propynyl, 1-
30 propenyl, 3-buten-1-ynyl, 3-methyl-1-butynyl, 3,3-dimethyl-1-butynyl, 1,3-pentadiynyl, 1-butynyl, ethynyl, vinyl, bromovinyl, phenylethynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl,
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triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and
5 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-, 4-, and 5-oxazolyl, 2- and 3-furanyl, and 2- and 3-pyrrolyl.

10

8. The oligomer of claim 1 wherein R² is 1-propynyl.

15

9. The oligomer of claim 8 wherein at least one substitute linkage is a phosphorothioate linkage.

10. The oligomer of claim 9 wherein all substitute linkages are phosphorothioate linkages.

20

11. The oligomer of claim 1 wherein at least one substitute linkage is a phosphorothioate linkage.

12. The oligomer of claim 11 wherein all substitute linkages are phosphorothioate linkages.

25

13. The oligomer of claim 1 wherein at least one linkage is a substitute linkage.

30

14. The oligomer of claim 13 wherein the substitute linkage is selected from the group consisting of phosphoramidate, phosphorothioate, methylphosphonate, riboacetal, amide, N-methylhydroxylamine,

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thionomethylphosphonate, phosphorodithioate, 2',5'
linkages, formacetal, and 3'-thioformacetal.

15 15. The oligomer of claim 14 wherein said
substitute linkage is methylphosphonate or
phosphorothioate.

10 16. The oligomer of claim 3 wherein at least
one substitute linkage is a phosphorothioate linkage.

17. The oligomer of claim 16 wherein all
substitute linkages are phosphorothioate linkages.

15 18. The oligomer of claim 3 wherein at least
one linkage is a substituted linkage.

20 19. The oligomer of claim 18 wherein the
substitute linkage is selected from the group consisting
of phosphoramidate, phosphorothioate, methylphosphonate,
riboacetal, amide, N-methylhydroxylamine,
thionomethylphosphonate, phosphorodithioate, 2',5'
linkages, formacetal, and 3'-thioformacetal.

25 20. The oligomer of claim 19 wherein said
substitute linkage is methylphosphonate or
phosphorothioate.

30 21. The oligomer of claim 1 that further
comprises at least one segment of inverted polarity.

22. The oligomer of claim 21 that further
comprises at least one o-xyloso switchback linker.

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23. The oligomer of claim 22 wherein the o-xyloso switchback linker comprises at least one base of formula (1) or (2) as defined in claim 1.

5 24. The oligomer of claim 1 wherein at least one base comprises a covalent bonding moiety.

25. The oligomer of claim 24 wherein said base is N⁴,N⁴-ethanocytosine.
10

26. The oligomer of claim 1 complexed with a cationic lipid.

27. The oligomer of claim 1 further comprising
15 from about 10 to about 30 nucleomonomers and having uniform polarity.

28. The oligomer of claim 27 further comprising about 2 to about 12 substituted linkages or
20 nucleomonomers at the 5'- end and at the 3'- end which comprise nuclease stable domains, and about 3 to about 26 substituted linkages or nucleomonomers which comprise at least one RNase H competent domain and is between the nuclease stable domains.

25 29. The oligomer of claim 3 complexed with a cationic lipid.

30 30. The oligomer of claim 3 further comprising from about 10 to about 30 nucleomonomers and having uniform polarity.

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31. The oligomer of claim 4 wherein said nucleomonomer is a 2'- modified nucleomonomer.

32. The oligomer of claim 31 wherein at least one of the nucleomonomer is a 2'-O-allyl modified nucleomonomer.

33. The oligomer of claim 1 having a covalent link between the 5' nucleomonomer and the 3' nucleomonomer whereby a circular oligomer is formed.

34. The oligomer of claim 1 conjugated to a solid support, label, or amine linker (1-12C).

35. The oligomer of claim 1 which is a dimer, trimer, tetramer, pentamer or hexamer.

36. The oligomer of claim 3 conjugated to a solid support, label, or amine linker (1-12C).

37. The oligomer of claim 3 which is a dimer, trimer, tetramer, pentamer or hexamer.

38. An oligomer of claim 1 comprising a positive modification comprising at least one base of formula (1) or (2) and a negative modification, with respect to the binding affinity of the oligomer to a complementary nucleic acid sequence, wherein the positive modification counteracts the effect of the negative modification to a degree that is more than additive with respect to the binding affinity.

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39. The oligomer of claim 38 wherein the positive modification R^2 is cyano, C_{2-12} 1-alkenyl or 1-alkynyl or is a C_{2-12} heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in which one to three of the ring atoms is independently N, S or O.

40. The oligomer of claim 39 wherein the heterocycle base modification R^2 is C_{2-8} 1-alkenyl or 1-alkynyl or is a C_{2-8} heteroaromatic or 1-ethynyl-heteroaromatic group containing 5 to 6 ring atoms in which one ring atom is N and optionally in which a second ring atom is N, S or O and each X is O.

41. The oligomer of claim 37 wherein the negative modification is a substitute linkage.

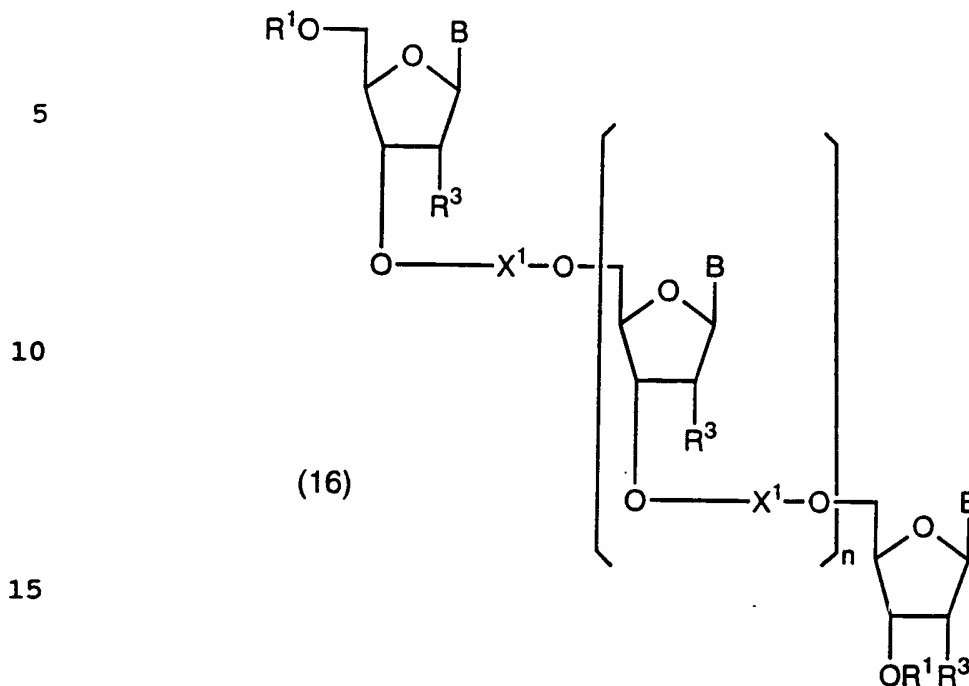
42. The oligomer of claim 41 wherein the substitute linkage comprises at least one linkage selected from the group consisting of phosphorothioate, thionomethylphosphonate, methylphosphonate, phosphoroamidate and triester for a phosphodiester linkage.

43. The oligomer of claim 1 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

44. The oligomer of claim 3 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

45. An oligomer of the formula (16):

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20 wherein each R^1 is independently H, PO_3^{2-} , or a blocking group;

each R^3 is independently selected from the group consisting of H, OH, F, NH_2 , OCH_3 , OC_2H_5 , OC_3H_7 , SCH_3 , SC_2H_5 , SC_3H_7 , OC_3H_5 , and SC_3H_5 ;

25 each X^1 is independently a substitute linkage selected from the group consisting of $-P(S)(O)-$, $-P(O)(O)-$, $-P(Me)(O)-$ and $-P(Me)(S)-$.

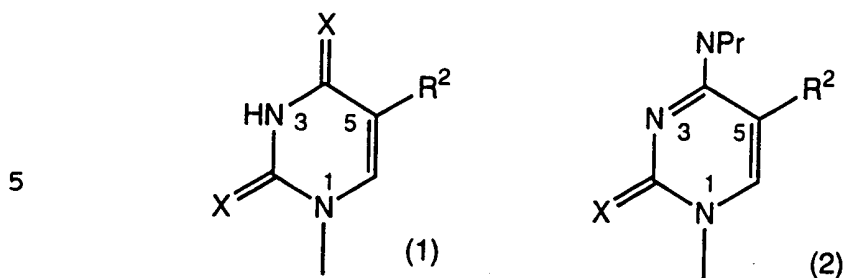
Pr is a protecting group;

n is an integer from 0 to 98; and

30 B is a purine or pyrimidine base, provided that at least one B is of formula (1) or (2):

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10 wherein each X is independently O or S; R²
is a group comprising at least one pi bond connected
through a carbon attached to the base; and
 Pr is H₂ or a protecting group and
with the proviso that when at least one of said
15 nucleomonomers of said oligomer comprises deoxyuridine 5-
substituted by vinyl, 1-butenyl, 1-pentenyl, 1-hexenyl,
1-heptenyl, 1-octenyl, 1-propynyl, 1-butynyl, 1-hexynyl,
1-heptynyl, or 1-octynyl, then the remainder of the
nucleomonomers comprising said oligomer are not solely
20 comprised of phosphodiester linked 2'-deoxyadenosine, 2'-
deoxyguanosine, 2'-deoxycytidine, thymidine or a
combination thereof.

25 46. The oligomer of claim 45 wherein at least
one B is 5-propynyluracil, 5-(3-methyl-1-butynyl)uracil,
5-propynylcytosine or 5-(3-methyl-1-butynyl)cytosine.

30 47. The oligomer of claim 45 wherein at least
one B is 2-thienyluracil, 2-thienylcytosine, 2-
imidazoyleuracil, 2-imidazoylecytosine, 2-thiazoyluracil or
2-thiazoylcytosine.

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48. The oligomer of claim 45 wherein at least one R¹ is H, PO₃⁻², DMT, MMT, H-phosphonate, methyl phosphonamidite, methylphosphoramidite, β-cyanoethylphosphoramidite or alkylphosphoramidite.

5

49. The oligomer of claim 45 wherein each R³ is independently H, OH, or -O-allyl.

50. The oligomer of claim 50 wherein at least one R³ is O-methyl, O-ethyl or O-propyl.

10

51. The oligomer of claim 45 wherein R² is 1-propynyl.

15

52. The oligomer of claim 51 further comprising from about 10 to about 30 nucleomonomers and having uniform polarity and further comprising about 2 to about 12 substituted linkages or nucleomonomers at the 5'- end and at the 3'- end which comprise nuclease stable domains, and about 3 to about 26 substituted linkages or nucleomonomers which comprise at least one RNase H competent domain and is between the nuclease stable domains.

20

53. The oligomer of claim 45 complexed with a cationic lipid.

25

54. The oligomer of claim 46 wherein the cationic lipid is DOTMA.

30

55. The oligomer of claim 45 wherein R² is not phenyl.

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56. The oligomer of claim 55 wherein at least one R^1 is H, PO_3^{2-} , DMT, MMT, H-phosphonate, methyl phosphonamidite, methylphosphoramidite, β -cyanoethylphosphoramidite or alkylphosphoramidite.

5

57. The oligomer of claim 55 wherein each R^3 is independently H, OH, or -O-allyl.

58. The oligomer of claim 55 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

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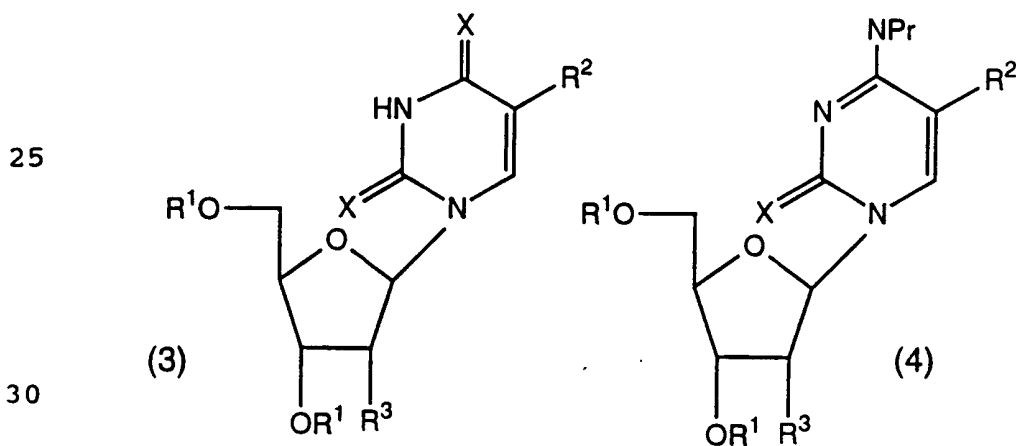
59. The oligomer of claim 55 complexed with a cationic lipid.

15

60. The oligomer of claim 59 wherein the cationic lipid is DOTMA.

61. A nucleomonomer having the structural formula (3) or (4):

20



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wherein each R¹ is independently H or a blocking group;

R² is a group comprising at least one pi bond connected through a carbon atom attached to the base;

5 Pr is (H)₂ or a protecting group; and

R³ is selected from the group consisting of H, OH, F, OCH₃, OC₂H₅, OC₃H₇, SCH₃, SC₂H₅, SC₃H₇, OC₃H₅, and SC₃H₅,

with the proviso that if R³ is H or OH, and both R¹ are H, R² is 1,3-pentadiynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-pyrimidine-ethynyl, 4-pyrimidine-ethynyl, 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 2- and 4-imidazolyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-thienyl-ethynyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-, 4-, and 5-thiazolyl-ethynyl, 2-, 4- and 5-oxazolyl-ethynyl, 4- and 5-thiazolyl, 4- and 5-oxazolyl, or 3-pyrrolyl.

62. The nucleomonomer of claim 61 wherein Pr is (H)₂.

20

63. The nucleomonomer of claim 61 wherein R² is 1-propynyl, 1-propenyl, 3-buten-1-ynyl, 3-methyl-1-butynyl, 3,3-dimethyl-1-butynyl, 1,3-pentadiynyl, 1-butynyl, ethynyl, vinyl, bromovinyl, phenylethynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-,

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4-, and 5-oxazolyl, 2- and 3-furanyl, or 2- and 3-pyrrolyl; and

the blocking group is DMT, MMT, Fmoc, hydrogen phosphonate, methylphosphonamidite, methylphosphoramidite
5 or β -cyanoethylphosphoramidite.

64. The nucleomonomer of claim 63 wherein R^3 is H, OH or O-allyl.

10 65. The nucleomonomer of claim 63 wherein R^2 is 1-propynyl.

66. The nucleomonomer of claim 63 wherein R^1 at the 3' position is selected from the group consisting
15 of hydrogen phosphonate, N,N-diisopropylamino- β -cyanoethoxyphosphine, N,N-diisopropyl-aminomethoxyphosphine, N,N-diethylamino- β -cyanoethoxyphosphine, N,N-morpholino- β -cyanoethoxyphosphine, N,N-morpholinomethoxyphosphine, N,N-diisopropylaminomethyl-
20 phosphonamidite, N,N-diethylamino-methylphosphonamidite, bis-morpholino-phosphine, N,N-dimethylamino- β -cyanoethyl-mercaptoposphine, 2-chlorophenyl phosphate, 4-chlorophenyl phosphate, 2,4-dichlorophenyl phosphate, 2,4-dibromophenyl phosphate, 2-chlorophenyl
25 thiophosphate, 4-chlorophenyl thiophosphate, 2,4-dichlorophenyl thiophosphate, and 2,4-dibromophenyl phosphate.

67. The nucleomonomer of claim 61 wherein R^2
30 is 1-propynyl.

68. The nucleomonomer of claim 61 wherein X is
35 O;

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R¹ at the 5' position is DMT, MMT or FMOC;

R¹ at the 3' position is N,N-diisopropylamino-
β-cyanoethoxyphosphine, N,N-diisopropylaminomethoxy-
phosphine or hydrogen phosphonate;

5 R² is 1-propynyl, 3-methyl-1-butyryl, 2-
thienyl, 2-imidazolyl or 2-thiazolyl;

R³ is H, OH, or O-allyl; and

Pr is (H)₂, diisobutylformamidine or another
protecting group.

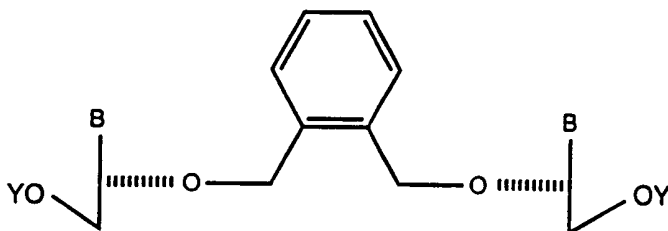
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69. The nucleomonomer of claim 68 wherein Pr
is benzoyl, diisopropylformamidine, FMOC, di-n-
butylformamidine, or isobutyryl.

15

70. An o-xyloso dimer of the formula (5):

20



(5)

25 wherein

each Y is independently R¹ or
an oligomer;

R¹ is H, PO₃⁻² or a blocking group; and

30 each B is independently a purine or pyrimidine
base, provided that at least one B is a base of formula
(1) or (2), wherein R₂ is a group comprising at least one
pi bond connected through a carbon atom attached to the
base; and Pr is (H)₂ or a protecting group.

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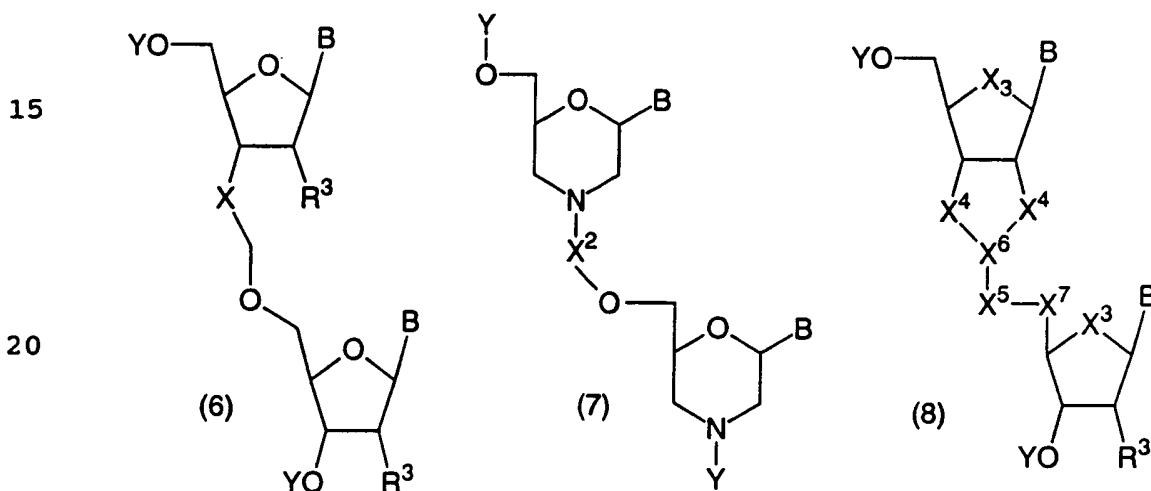
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71. The dimer of claim 70 wherein R^2 is 1-propynyl.

72. The dimer of claim 70 wherein the blocking group is selected from the group consisting of DMT, MMT, hydrogen phosphonate, methylphosphonamidite, methylphosphoramidite, and β -cyanoethylphosphoramidite.

73. A dimer of the formula (6), (7) or (8):

10



20

25

wherein

X is selected from the group consisting of O and S;

30 X² is selected from the group consisting of CO, CS and SO₂;

35 X³ is independently selected from the group consisting of O, S, CH₂, CF₂ and CFH;

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X^4 is independently selected from the group consisting of O, S, SO, SO_2 , CH_2 , CO, CF_2 , CS, NH and NR^4 wherein R^4 is lower alkyl (C_{1-4} ; methyl, ethyl, propyl, isopropyl, butyl or isobutyl);

5 X^5 is selected from the group consisting of O, CO, S, CH_2 , CS, SO_2 , CO, NH and NR^4 ;

X^6 is selected from the group consisting of CH, N, CF, CCl, and CR^5 wherein R^5 is lower alkyl (C_{1-4}) fluoromethyl, difluoromethyl, trifluoromethyl or lower
10 fluoroalkyl (C_{2-4} , F_{1-5});

X^7 is selected from the group consisting of O, S, CH_2 , CO, CF_2 and CS;

each Y independently is an oligomer or R_1 wherein R_1 is PO_3^{2-} or a blocking group;

15 each R^3 is independently selected from the group consisting of H, OH, F, NH_2 , OCH_3 , OC_2H_5 , OC_3H_7 , SCH_3 , SC_2H_5 , SC_3H_7 , OC_3H_5 , and SC_3H_5 ;

each B is independently a purine or pyrimidine base, provided that at least one B is of formula (1) or
20 (2) wherein each X is O or S;

R_2 is a group comprising at least one pi bond connected through a carbon atom attached to the base; and Pr is (H)₂ or a protecting group;

25 and further provided that X^5 and X^7 are not both O.

74. The dimer of claim 73 wherein R^1 is PO_3^{2-} , DMT, MMT, H-phosphonate, methylphosphoramidite or β -cyanoethylphosphoramidite.
30

75. The dimer of claim 73 wherein at least one B is 5-propynyluracil, 3-methyl-1-butynyluracil, 5-propynylcytosine, or 3-methyl-1-butynylcytosine.
35

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76. The dimer of claim 73 wherein at least one R^2 is propynyl, R^3 is H or OH and X in the substitute linkage is S.

5 77. The dimer of claim 73 of formula (8) wherein X^3 and X^4 are O, X^5 and X^7 are CH_2 , and X^6 is CH.

10 78. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 1.

15 79. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 45.

20 80. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 1.

25 81. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 45.

30 82. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 3.

35 83. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 55.

40 84. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 3.

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85. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 55.

5 86. The oligomer of claim 1 wherein the oligomer persists intact in cells or biological solutions for a period of time that is greater than a corresponding oligodeoxynucleotide.

10 87. The oligomer of claim 3 wherein the oligomer persists intact in cells or biological solutions for a period of time that is greater than a corresponding oligodeoxynucleotide.

15 88. The oligomer of claim 1 wherein the oligomer is a ribozyme.

 89. The oligomer of claim 3 wherein the oligomer is a ribozyme.

20 90. The oligomer of claim 1 wherein the oligomer is a probe.

 91. The oligomer of claim 3 wherein the oligomer is a probe.

 92. The oligomer of claim 1 wherein the oligomer is a primer.

30 93. The oligomer of claim 3 wherein the oligomer is a primer.

 94. A pharmaceutical composition, comprising:

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a pharmaceutically acceptable carrier; and
a therapeutically effective amount of an
oligomer of claim 1.

5 95. A method of treating a disease in a
subject, which disease is characterized by a particular
DNA duplex or RNA, comprising the steps of:

 administering to a subject in need of such
treatment a therapeutically effective amount of an
10 oligomer of claim 1; and
 allowing the oligomer to have sufficient time
to bind to the DNA duplex or RNA.

 96. A method of treating a disease in a
15 subject, which disease is characterized by a particular
DNA or RNA, the method comprising:

 administering to a subject in need of such
treatment a therapeutically effective amount of an
oligomer of claim 1; and
20 allowing the oligomer to have sufficient time
to bind to the DNA or RNA to form a triplex or duplex.

 97. A method of detecting the presence,
absence or amount of a particular double stranded or
25 single stranded nucleic acid in a biological sample,
comprising the steps of:

 contacting the sample with an oligomer of claim
1 under conditions wherein a duplex or a triplex is
formed between the oligomer and the nucleic acid; and
30 detecting the presence, absence or amount of
said duplex or triplex.

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98. A method of detecting the presence, absence or amount of a particular single-stranded DNA or RNA in a biological sample, comprising the steps of:

contacting the sample with an oligomer of claim
5 1 under conditions wherein a hybrid duplex is formed between the oligomer and the DNA or RNA; and
detecting the presence, absence or amount of said duplex.

10 99. A method of inhibiting expression of at least one selected protein in a cell wherein the protein is encoded by DNA sequences and the protein is translated from RNA sequences, comprising the steps of:

introducing an oligomer of claim 1 into the
15 cell; and
permitting the oligomer to form a triplex with the DNA or RNA or a duplex with the DNA or RNA whereby expression of the protein is inhibited.

20 100. The method of claim 99 wherein the oligomer is introduced into the cell by a method selected from the group consisting of calcium phosphate transfection, DMSO transfection, dextran transfection, electroporation, cationic lipid transfection, anionic
25 lipid transfection or liposome transfection.

101. A method of introducing an oligomer of claim 1 into cells, comprising:

mixing the oligomer with a permeation enhancing
30 agent to form a complex; and
contacting the complex with the cells.

35 102. A pharmaceutical composition, comprising:

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a pharmaceutically acceptable carrier; and
a therapeutically effective amount of an
oligomer of claim 3.

5 103. A method of treating a disease in a
subject, which disease is characterized by a particular
DNA duplex or RNA, comprising the steps of:

 administering to a subject in need of such
treatment a therapeutically effective amount of an
10 oligomer of claim 3; and
 allowing the oligomer to have sufficient time
to bind to the DNA duplex or RNA.

 104. A method of treating a disease in a
15 subject, which disease is characterized by a particular
DNA or RNA, the method comprising:

 administering to a subject in need of such
treatment a therapeutically effective amount of an
oligomer of claim 3; and
20 allowing the oligomer to have sufficient time
to bind to the DNA or RNA to form a triplex or duplex.

 105. A method of detecting the presence,
absence or amount of a particular double stranded or
25 single stranded nucleic acid in a biological sample,
comprising the steps of:

 contacting the sample with an oligomer of claim
3 under conditions wherein a duplex or a triplex is
formed between the oligomer and the nucleic acid; and
30 detecting the presence, absence or amount of
said duplex or triplex.

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106. A method of detecting the presence, absence or amount of a particular single-stranded DNA or RNA in a biological sample, comprising the steps of:

- 5 contacting the sample with an oligomer of claim 3 under conditions wherein a hybrid duplex is formed between the oligomer and the DNA or RNA; and
 detecting the presence, absence or amount of said duplex.

- 10 107. A method of inhibiting expression of at least one selected protein in a cell wherein the protein is encoded by DNA sequences and the protein is translated from RNA sequences, comprising the steps of:

- 15 introducing an oligomer of claim 3 into the cell; and
 permitting the oligomer to form a triplex with the DNA or RNA or a duplex with the DNA or RNA whereby expression of the protein is inhibited.

- 20 108. The method of claim 107 wherein the oligomer is introduced into the cell by a method selected from the group consisting of calcium phosphate transfection, DMSO transfection, dextran transfection, electroporation, cationic lipid transfection, anionic
25 lipid transfection or liposome transfection.

109. A method of introducing an oligomer of claim 1 into cells, comprising:
 mixing the oligomer with a permeation enhancing
30 agent to form a complex; and
 contacting the complex with the cells.

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110. A method of introducing an oligomer of claim 3 into cells, comprising:

mixing the oligomer with a permeation enhancing agent to form a complex; and

5 contacting the complex with the cells.

111. A method of synthesizing a desired oligomer of claim 1, comprising the steps of:

10 synthesizing a protected nucleomonomer synthon having a protecting group and a base and further having a coupling group capable of coupling to a nucleomonomer or oligomer;

15 coupling the nucleomonomer synthon to an acceptor nucleomonomer or an acceptor oligomer;
removing the protecting group; and
repeating the cycle as needed until the desired oligomer is synthesized.

112. A method of synthesizing a desired oligomer of claim 1, comprising the steps of:

20 synthesizing a protected oligomer synthon having a protecting group and a base and further having a coupling phosphite or phosphate group capable of coupling to a nucleomonomer or oligomer;

25 coupling the oligomer synthon to an acceptor nucleomonomer or an acceptor oligomer;
removing the protecting group; and
repeating the cycle as needed until the desired oligomer is synthesized.

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113. The method of claim 111 wherein the coupling step is accomplished using hydrogen phosphonate, amidite or triester chemistry.

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114. The method of claim 111 wherein the coupling phosphite or phosphate group is selected from the group consisting of hydrogen phosphonate, N,N-diisopropylamino-methylphosphonamidite, N,N-diethylmethylamino-phosphonamidite, N,N-diisopropylamino- β -cyanoethoxyphosphine, N,N-diisopropylamino-methoxyphosphine, N,N-diethylamino- β -cyanoethoxyphosphine, N,N-morpholino- β -cyanoethoxyphosphine, N,N-morpholino-methoxyphosphine, 2-chlorophenyl phosphate, 4-chlorophenyl phosphate, 2,4-dichlorophenyl phosphate, 2-chlorophenyl thiophosphate, 4-chlorophenyl thiophosphate, 2,4-dichlorophenylthiophosphate, and 2,4-dibromophenyl phosphate.

115. A method to synthesize a derivatized oligomer of claim 1 which comprises:

reacting an oligomer containing at least one 5-iodouracil, 5-iodocytosine or N⁴-protected-5-iodocytosine heterocycle with R²H in the presence of a Pd catalyst so as to convert said 5-iodouracil, 5-iodocytosine or N⁴-protected-5-iodocytosine to the corresponding 5-R² substituted heterocycle.

116. A method of synthesizing a derivatized oligomer of claim 1, comprising the steps of:

synthesizing a protected precursor nucleomonomer synthon having a protecting group and 5-iodouracil or N⁴-protected-5-iodocytosine as a base; coupling the protected precursor nucleomonomer synthon to an acceptor nucleomonomer or an acceptor oligomer; removing the protecting group;

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repeating the cycle as needed until the oligomer is synthesized; and

derivatizing the precursor nucleomonomer synthon in said oligomer to a derivative having R² at the 5-position, where R² has the meaning defined in claim 1.

117. A method to evaluate a candidate antisense oligomer for its ability to inhibit gene expression, which method comprises

10 microinjecting said candidate antisense oligomer into a recombinant host cell along with (a) a target vector for the expression of a gene containing a target sequence for said candidate antisense oligomer, and (b) with a control vector for the expression of a
15 control gene encoding a detectable protein, wherein said control gene does not contain said target sequence.

118. The method of claim 117 wherein said target vector is injected at about 2-4 copies per cell
20 and said control vector is injected at about 30-50 copies per cell.

119. The method of claim 117 wherein said detectable protein is chloramphenicol acetyl transferase,
25 luciferase or β -galactosidase.

120. The method of claim 117 wherein said host cell is a mammalian cell.

30 121. A host cell which has been microinjected with (a) a target vector containing an expression system for a gene containing a target sequence for an antisense

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oligomer, (b) a control vector containing an expression system for a detectable protein, and (c) a candidate antisense oligomer.

5 122. A method of amplifying nucleic acid
comprising the steps:
 mixing the oligomer of claim 1 with a sample
 containing target nucleic acid;
 hybridizing the oligomer with the target
10 nucleic acid; and
 amplifying the target nucleic acid by PCR or
LCR.

 123. A method of amplifying nucleic acid
comprising the steps:
15 mixing the oligomer of claim 3 with a sample
containing target nucleic acid;
 hybridizing the oligomer with the target
nucleic acid; and
 amplifying the target nucleic acid by PCR or
20 LCR.

 124. The oligomer of claim 1 wherein the
oligomer is an antisense oligomer.

25 125. The oligomer of claim 3 wherein the
oligomer is an antisense oligomer.

 126. The oligomer of claim 1 wherein the
oligomer is a triple helix oligomer.

30 127. The oligomer of claim 3 wherein the
oligomer is a triple helix oligomer.

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